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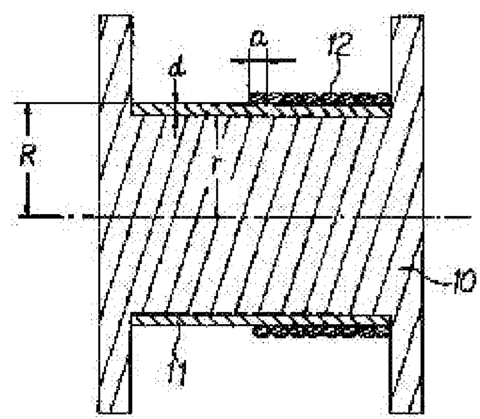
(54) BOBBIN FOR WINDING OPTICAL FIBER

(57)Abstract:

PURPOSE: To reliably prevent collapse of winding of an optical fiber wound around a bobbin when a temperature change in a specified range allowable during conveyance is produced by covering the winding barrel of a bobbin with a resilient cylinder material having the coefficient thermal expansion by which a specified formula is satisfied.



CONSTITUTION: A bobbin for winding an optical fiber used for winding of an optical fiber 12 for storage and conveyance has a winding barrel 10 covered with a resilient cylinder material 12 having the coefficient of thermal expansion satisfying an undermenthioned formula. The formula is r (1-10k1)+d(1-10k2)> {R/(1+T/SE3)}(1-10k3). In the formula, R is equal {(r+d)+[(r+d)2-4T/a×(r/E1+ d/E2)]1/2} 2 and r, k1, and E1 are the radius, the coefficient of thermal expansion, the Young's modulus, respectively, of the winding barrel 10, and (a), k3, E3, S and T are the width the coefficient of thermal expansion, the Young's modulus, the sectional area, and the winding tension, respectively, of the optical fiber 12.

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention can relate to the bobbin used in order to roll round and keep and convey optical FABA, and can prevent certainly volume collapse of the optical fiber wound around the bobbin to the temperature change in the fixed range permitted during storage and conveyance.
[0002]
[Description of the Prior Art]It is usually a product made from a plastic, or metal, and as compared with these, predetermined twists and, as for the winding drum of the bobbin for optical fiber rolling up, the optical fiber whose coefficient of thermal expansion is very small is rolled round by power. When the tension applied to an optical fiber at the time of rolling up of an optical fiber is too weak, storage, Volume collapse is produced by vibration at the time of the volume slack by the temperature change at the time of conveyance, and conveyance, A possibility of becoming a value with larger measured value of the path loss examination of an optical fiber done winding around a bobbin so that the above-mentioned tension was strong on the contrary than the original path loss of an optical fiber, for this reason becoming the inferior goods by path loss examination increases. Conventionally, in the limit which does not produce volume collapse, it rolls round as much as possible, the optical fiber at the time twists, and power (tension applied to an optical fiber) is made small in order to plan balance of opposite above-mentioned both sides, and to bring a path loss test result close to an original path loss result as much as possible. However, making the result of a path loss examination into a sacrifice to some extent in consideration of the volume slack by the difference of the heat contraction of the winding drum accompanying a temperature change, and an optical fiber, the strength which expected the above-mentioned volume slack cannot but twist, and it cannot but roll round with power. Roll round this volume slack and it is low as compared with the

temperature at the time, [of the temperature at the times of use, such as at the time / At the time of conveyance / of a path loss examination, etc.] Since it produces by a winding drum's contracting greatly compared with contraction of an optical fiber, and losing the bearing power to the method of the outside of the radial direction over the optical fiber by a winding drum, in order to prevent this, there is no outside compensated with **** of the above-mentioned bearing power by a winding drum by other means.

[0003]

[Problem(s) to be Solved by the Invention]Let it be the technical problem for this invention to make small the volume slack of the optical fiber by a temperature change as much as possible for the purpose of the optical fiber at the time of rolling up by taking a temperature change into consideration twisting, making the increment of power small, and making small path loss in a path loss examination as much as possible.

[0004]

[Means for Solving the Problem]A means provided for aforementioned problem solution is constituted by the following element (b) and (**).

(b) The coefficient-of-thermal-expansion k_2 shall satisfy [having made a winding drum of a bobbin cover with an elastic cylindrical material,] the following formula for material of the (**) above-mentioned elastic cylindrical material.

[Number 3]

$$r\,(1-10k_1)+d\,(1-10k_2)>\{R/(1+T/SE_3)\}\,(1-10k_3)。$$

However, the above-mentioned R is taken as a value with which it is satisfied of the following formula.

[Number 4]

$$R=\{(r+d)+\sqrt{(r+d)^2-4T/a\times(r/E_1+d/E_2)}\}/2。$$

Each sign of the above-mentioned formula is as follows, respectively.

: r A coefficient of thermal expansion of a radius (mm) k_1:winding drum of a winding drum (1-/**), E_1: Young's modulus (g/mm^2) of a winding drum, d : Thickness of an elastic cylindrical material wound around a bobbin (mm), k_2 : A coefficient of thermal expansion of an elastic cylindrical material wound around a bobbin (1-/**), E_2 : Young's modulus of an elastic cylindrical material wound around a bobbin (g/mm^2), a A coefficient of thermal expansion (1-/**) of a width (mm) k_3:line object, E_3 : Young's modulus (g/mm^2) of a line object, S : A cross-section area (mm^2) of a line object, T : Volume tension (g) of a line object, [of :line object

(optical fiber wire)] [0005]

[work --] for temperature at the time of rolling up of all the things related to a temperature change in a formula of the above conditions -- and -- twisting -- power. Since all the requirements which influence stiffness of a volume of a line object are woven in, change of a diameter by a temperature change, or length, change of elastic deformation twist and according to power, change of internal stress, etc., Also when temperature at the time of rolling up and temperature at the time of use (at for example, the time of a path loss examination) fall by 10 degrees, bearing power to a method of the outside of the radial direction over a cylindrical bunch of a line object (optical fiber wire) by an elastic cylindrical material does not become zero. That is, power is prevented from an elastic cylindrical material compensating a reduced part of an outer diameter accompanying a temperature change of a winding drum, and a line object over a winding drum twisting, and becoming zero. Therefore, below 10 degrees, a temperature fall is not concerned with reduction of an outer diameter of a winding drum accompanying a temperature change, and does not produce volume collapse by volume slack. It is as follows when details of the above-mentioned operation are explained phenomenally, referring to drawing 1. Tension is applied to a line object and the periphery 2 of elastic cylindrical materials, such as sponge, is compressed to 2' shown by a dotted line. Although a line object also twists the periphery 1 of a winding drum and it is compressed by power at this time, since Young's modulus of a winding drum is very larger than an elastic cylindrical material, that compression amount is very small compared with a compression amount of an elastic cylindrical material. If temperature at the time of conveyance, etc. falls as compared with temperature at the time of rolling up, a line object wound around a winding drum, an elastic cylindrical material, and an elastic cylindrical material will be contracted at a rate of each coefficient of thermal expansion. Since coefficient-of-thermal-expansion k_3 of a line object (optical fiber) is very small compared with coefficient-of-thermal-expansion k_1 of a winding drum and an elastic cylindrical material, and k_2, if a periphery of a winding drum contracts to a position shown by dotted-line 1', will carry out heat contraction also of the elastic cylindrical material with this, but. While inner circumference of an elastic cylindrical material greatly compressed by clamp capacity of a line object carries out elastic restoration to a method of the inside of a radial direction, contraction of a winding drum periphery is followed, and a part for heat contraction of a winding drum is compensated. Although bearing power over a line object of an elastic cylindrical material decreases by elastic restoration to a method of the inside of a radial direction of this elastic cylindrical material, as long as that coefficient-of-thermal-expansion k_2 fills a relation of the above-mentioned formula, in the above-mentioned temperature fall, below 10 degrees, bearing power does not become zero. Subsequently, an antecedent basis of the above-mentioned formula is explained for a sense,

referring to drawing 2. Change of a path of a winding drum and a path of a line object (optical fiber wire) wound around a winding drum is with what is depended on a temperature change, and a thing to depend on change of strain power of a line object. When temperature of a winding drum when a line object is rolled round falls in t from t_0, a winding drum is contracted and it is this shrinkage amount ($t(k_1r+k_2d)\ _0$-t). A size of heat contraction of a line object rolled round in temperature t_0', the strain power T, and the volume radius R is k_3R (t_0'-t). Since a line object is rolled round by the tension T, it is rolled round in the state where it was extended with this tension T. When a winding drum contracts, a reduction amount of a wound diameter by tension relaxation when tension of a line object becomes small and tension becomes zero is set to R $\{1-1/(1+T/SE_3)\}$. The antecedent basis of this formula is as follows. When the free length of the radius R of a line object in the state where it twisted around a winding drum, and a line object for one volume is set to L, the tension T, and elongation epsilon, it is 2piR=L (1+epsilon). When a cross-section area of a line object is set to S, they are epsilon=sigma/E =1/ExT/S. Future, $L=2piR/(1+T/SE_3)$

At the time of T= 0, since it becomes free length, line objects are radius R'=L/2pi at this time. Variation $R-R'=R-L/2pi=R-R/(1+T/SE_3)$ =R of a radius $\{1-1/(1+T/SE_3)\}$. Next, R is explained. A line object hits R of the above [much more volume radius of an innermost layer in the state where it was rolled round by winding drum]. When a line object of the width a is twisted around a winding drum by the tension T, stress applied at right angles to a winding drum peripheral face with a line object directly twisted around a peripheral face of a winding drum serves as T/Ra (explanation of an antecedent basis drawn since this is the general formula known well conventionally is omitted.). Since this stress was applied to a peripheral face of the elastic cylindrical material 11 and is further applied to a peripheral face of the winding drum 10, the winding drum 10 and the elastic cylindrical material 11 are compressed by this stress only r $(1-T/RaE_1)$ and d $(1-T/RaE_2)$, respectively. However, this d is the thickness in a free state of an elastic cylindrical material. Because the radius is R when the line object 12 is twisted around a peripheral face of an elastic cylindrical material of a radius of r+d by the tension T by a free state, [Number 5]

$$R=(r+d)-T/Ra\times(r/E_1+d/E_2).$$

It becomes. Since this is a secondary equation about R, if this is solved,[Number 6]

$$R=\{(r+d)+\sqrt{(r+d)^2-4T/a\times(r/E_1+d/E_2)}\}/2.$$

It becomes. in order not to produce extreme volume collapse due to the temperature fall after a line object rolled round by periphery of an elastic cylindrical material rolling round, a radius of a

periphery of an elastic cylindrical material after heat contraction is larger than a wound diameter of a line object in which tension of a line object after heat contraction becomes zero -- the minimum -- they are required conditions. If this condition is expressed with a formula,
[Number 7]

$$r\{1-k_1(t_0-t)\}+d\{1-k_2(t_0-t)\}>\{R/(1+T/SE_3)\}\times\{1-k_3(t_0'-t)\}。$$

It becomes. In this formula, it is t. : Because it is t_0-t=10 when a fall of temperature is made into 10 degrees temperature (**) of a line object at the time of temperature (**) t_0':line object rolling up, and there, [of a winding drum at the time of operating temperature (**) t_0:line object rolling up] [Number 8]

$$r(1-10k_1)+d(1-10k_2)>\{R/(1+T/SE_3)\}(1-10k_3)。$$

It becomes. That is, even if it rolls round by choosing that material and descends 10 degrees rather than temperature so that coefficient-of-thermal-expansion k_2 of an elastic cylindrical material may fill the above-mentioned relation, due to this temperature fall, a line object twists and power does not become zero.
[0006]
[An example of real **] Subsequently, one concrete example is described.
About a winding drum, they are 150-mm [of a winding drum of a bobbin / in radius], material:synthetic resin (name ABS plastics), and coefficient-of-thermal-expansion k_1=0.0001-/**, and Young's modulus E_1=200kg[/mm] ^{2}. What twisted lightly a 5-mm-thick band-like elastic member around a winding drum about an elastic cylindrical material, material: Foamed resin (name polyethylene foam). Coefficient-of-thermal-expansion k_2=0.0002-/**, Young's modulus E_2=30g[/mm] ^{2}, About a line object, a= 1.1 mm in width of an optical fiber wire, execution cross-section area ^{2} of S= 0.049 mm, Temperature t_0'=25 ** of coefficient-of-thermal-expansion k_3=0.0000005-/** of this optical fiber wire, Young's modulus E_3=7300kg [/mm] ^{2}, and a line object at the time of rolling up. About rolling-up conditions, they are temperature t_0=25 ** of a winding drum at the time of rolling up, rolling-up tension of T= 150 g, and rolling-up length:10km. About a test result, ten bobbins rolled round on condition of above prepared, and this was rolled round, it lowered to 15 ** lower 10 ** than temperature, and a

vibration test was done. As a result, what produced volume collapse did not have one. Ten things which rolled round the same line object as a winding drum (what does not twist an elastic cylindrical material) of the completely same bobbin as a bobbin and the above which were made into a comparison object on the same conditions were prepared, and this was rolled round, it lowered to 15 ** lower 10 ** than temperature, and a vibration test was done. As a result, the number of those from which what produced volume collapse did not produce two pieces and volume collapse was eight.

[0007]

[Effect **] Volume slack by the temperature conditions and volume collapse can be certainly prevented by expecting temperature of temperature at the time of use at the time of conveyance as explained above. Therefore, an optical fiber can be rolled round by necessary minimum tension, and an effect of being able to measure original path loss of an optical fiber correctly by this is produced.

[Translation done.]